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COST/BENEFIT ANALYSIS OF THE ARMY EDUCATION
INFORMATION SYSTEM (ARIES)

JoAnn H. Bowlsbey and Carol M. Rabush
Discover Foundation, Inc.

BASIC SKILLS INSTRUCTIONAL SYSTEMS TECHNICAL AREA



U. S. Army

Research Institute for the Behavioral and Social Sciences

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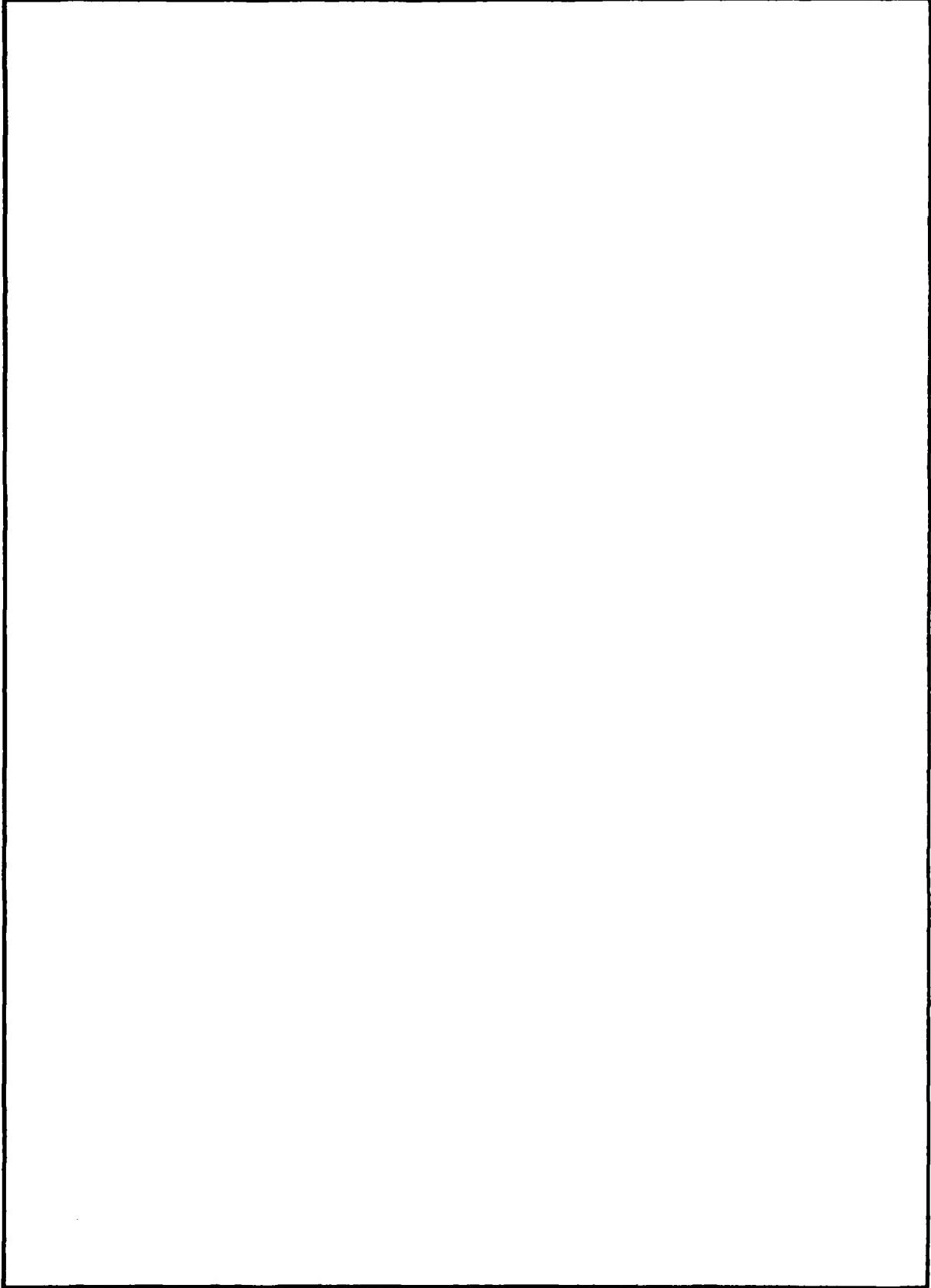
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The purpose of this document is to (1) indicate alternative modes for the delivery of the Army Education Information System (AREIS) to Army Education Centers world wide; (2) project cost figures related to each of these delivery modes, and (3) indicate anticipated benefits which may accrue to the Army and to soldiers by use of the computer system.		

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INTRODUCTION

BACKGROUND

One of the important objectives of the Army Continuing Education System (ACES) is to provide information about educational and career options to military personnel. The goal of this service is to enhance the personal and military effectiveness of these individuals, thereby strengthening the effectiveness of the military unit of which they are a part.

In recent years the information which relates to the Army Continuing Education System has become more extensive and complex. Consequently, Education Center Counselors have found themselves engaged more often in the tasks of gathering and dispensing routine information than in the tasks for which they have been trained, that of counseling and consultation.

The Army Research Institute, recognizing that the computer has become an important tool in the field of guidance over the last decade, contracted with the DISCOVER Foundation to conceptualize and develop a prototype of the Army Education Information System (AREIS). As a first step in the development process, the Foundation conducted a worldwide needs assessment to determine, among other things, 1) the level of importance of each of the ACES programs, and 2) the approximate amount of time which counselors spend describing these programs to clients. The results of this survey can be found in ACES NEEDS ASSESSMENT SURVEY, DISCOVER Foundation, December 1979, a report prepared for Army Research Institute for the Behavioral and Social Sciences under contract MDA 903-79-C-0279.

After careful evaluation of the survey information, the Foundation conceptualized AREIS, a computer-based program which has two separate, though interacting, systems. The first system, designed for use by soldiers, provides a number of interactive instructional scripts. It is composed of three parts: Subsystem I (Orientation) introduces the user to the content of AREIS, to the services of the Education Center, and to the various programs which make up the Army Continuing Education System. Subsystem II (Self-Information) helps users to define and assess work-related interests, skills, and values in order to prepare them to identify an educational or a vocational goal. Subsystem III (Goals and Planning) sets forth a number of short- and long-term goals which can be met during the period of military service or after separation from the service. AREIS is designed to permit easy transfer from one subsystem to either of the other two as desired.

The second system, the Counselor-Administrator system, is central to AREIS and overlaps the soldier system, providing both the counselor and the soldier with the databases which support AREIS. Other important features of this system include the capability to display master schedules of courses given through the Education Center, modification of the soldier Educational Development Record (DA Form 669), and data compilation for planning and/or summary report purposes. The figure on the next page describes the relationship between the four components of AREIS. A complete description of AREIS can be found in THE ARMY EDUCATION INFORMATION SYSTEM (AREIS): A CONCEPTUALIZATION, DISCOVER Foundation, December 1979, a report prepared for Army Research Institute for the Behavioral and Social Sciences under contract MDA 903-79-C-0279.

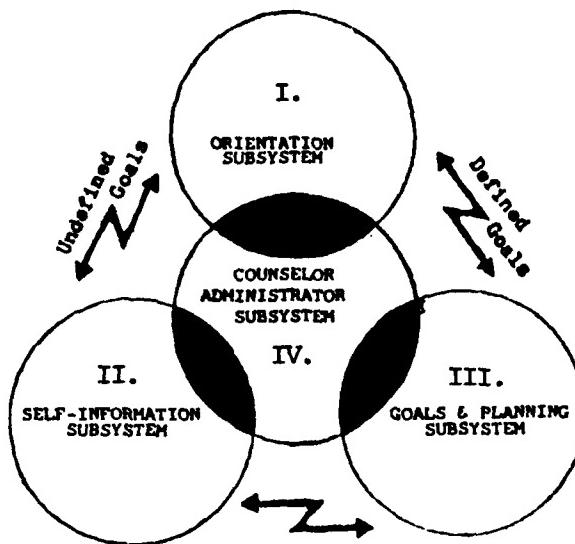


Figure 1

**The Relationship Between
the Four Components of AREIS**

The following portions of AREIS were written and programmed during the present contract:

- all of Subsystem I
- the on-line administration, scoring, and interpretation of an interest assessment survey, the UNIACT IV,* a part of Subsystem II
- the goal, "To Complete a Next Step in Education," a part of Subsystem III
- several frames, such as the computerization of DA Form 669 and storage and display of master schedules of courses given on or near post, a part of Subsystem IV.

*The UNIACT IV is published as a part of VIFSA (the Vocational, Experience, and Skill Assessment). ©American College Testing Program, 1978.

A decision was made by the Army Research Institute staff to use PLANIT, the Programming Language for Interactive Teaching, as the authoring language for AREIS. There were several reasons for this decision, including the following: 1) the software was resident in the Army computer at Edgewood Arsenal, MD, and therefore immediately available for use by development staff; 2) the authoring language is easy to learn; and, 3) the developers of AREIS could spend their energies and resources on the completion of the courseware without commitment to development of supporting software. It became evident during the development work that PLANIT had some problems which would negatively impact the effectiveness of the delivery of AREIS. These problems included: 1) the scrolling of the text on the terminal screen; 2) the restriction of user responses to one per screen; and, 3) the inability of PLANIT to support databases--an important part of AREIS as conceptualized. Because the positive features seemed to outweigh the negative aspects of PLANIT, for this initial work at least, it was decided to continue the programming of the prototypal system using this authoring language.

The prototypal AREIS system was the subject of a field tryout held at Fort Sill Education Center during April 1980. Results of this field tryout activity can be found in FIELD TRYOUT OF THE ARMY EDUCATION INFORMATION SYSTEM (AREIS), DISCOVER Foundation, August 1980, a report prepared for Army Research Institute for the Behavioral and Social Sciences under contract MDA 903-79-C-0279.

PURPOSE

The purpose of this document is threefold: 1) to examine alternative modes by which AREIS might be delivered to Army Education Centers worldwide; 2) to project cost figures related to each of these delivery modes; and, 3) to anticipate benefits which will accrue to the Army and to soldiers by use of the computer system. In the final section, recommendations are made about the most cost-feasible and beneficial mode of delivery. In making these recommendations, the following assumptions are made:

1. the AREIS system which is implemented will include the Soldier subsystems and the Counselor-Administrator subsystem which includes the computer storage and retrieval DA Form 669;
2. the computer which delivers AREIS should be capable of expansion to support other computerized functions or systems which the Army may develop (e.g., transcript registry program; the computerized system for evaluating ACES programs; and a management information system) for use in Education Centers;
3. communication via the computer should be established "horizontally" among Education Centers and "vertically" through the Army education system, that is, among these centers, the Education Divisions of the Major Commands (MACOMS), and the Education Directorate, Headquarters, Department of Army;
4. response time in an on-line application such as AREIS is critical and a mean response time of five seconds or less for soldier interaction should be planned for;

5. the system must be capable of handling terminals in a variety of configurations since posts vary greatly in size and Education Centers may be either centralized or decentralized in physical setting or function;
6. individual Education Centers on posts should be expected to provide a minimum of technical support to the system, such as turning the system on and off each day and generating and/or maintaining local information on the system; and,
7. although the PLANIT software was usable for the development/research purposes of the study, unless a number of problems inherent in its present design can be remediated, PLANIT is inappropriate for full-scale implementation of AREIS.

The evaluation of the delivery modes proposed in the following pages was conducted in light of these assumptions. In fact, these assumptions are used as the criteria upon which recommendations found at the conclusion of this section are based. (See page 18). The elimination or modification of any of these assumptions might modify the recommendations.

COST FACTORS RELATED TO THE DELIVERY OF AREIS

Alternative 1: The Use of Existing Computers

The cost of providing a computer-based education information system such as AREIS on Army posts is dependent upon two factors: 1) the amount of "slack" which currently exists in computer resources on Army posts; and 2) the ability to provide the best combination of hardware, software, and data communication capability which will meet the proposed criteria previously outlined.

The first factor, that is, the amount of computer resource that now exists on Army posts, is difficult to identify because it is, by nature, a dynamic variable. All posts in the continental United States (CONUS) currently have at least one computer on site. Most of these machines are IBM 360 computers which provide support for the administrative activities on post (BASFOPS). Virtually all of these BASFOPS computers are overloaded with the day-to-day activities of business computing. There are also some UNIVAC 1100 and DEC 11 series machines (among others)¹ which are used for more specific purposes such as support for instructional activities or word processing systems. The IBM and UNIVAC computers are generally old (late 1960's—early 1970's) and make use of outdated operating systems designed for batch computing (payroll, financial reports, etc.). The DEC computers, where they exist, are overloaded with interactive computing applications that cannot be executed by either the IBM or UNIVAC which may be co-located on the same post. These machines were selected on the basis of then-present requirements; a system such as AREIS, with its supporting data files, was not anticipated.

Another problem is that of data communication, that is, the transmission of data from one location to another using telephone lines or cables. Intra-post communication links are limited, and inter-post links are typically non-existent. Further, the amount of core and disk capability available in these machines for the provision of AREIS to the Education Centers is not clearly known. Considering the limited amount of computer resources available, however, there is probably little core or disk space available without hardware upgrades. Real-time processing necessary to support acceptable response time for soldier interaction with AREIS is generally not available.

The situation with regard to computers located outside the continental United States is even more complex. There is a large variety of computers in use² and present information neither indicates the existence of a systematic or integrated plan for computer usage nor identifies the amount of core and disk space available now or for future applications. Further, the quantity and quality of data communication links are very limited. Telecommunications are leased in CONUS; they must be purchased in Europe and Asia. And the fact that there are different companies controlling communications in different countries exacerbates an already complicated situation. In dealing outside

¹ADPMIS Summary of DPI's and Computer Systems. Department of the Army, Office of Chief of Staff, Washington, D.C. (June 1980), pp. 51-69.

²Ibid., pp. 51-69.

the U.S., then, the system configuration and the location of all its components must be fixed and known in order to provide a realistic cost figure for data communications.

It is important to know what plans are being made to update or replace existing hardware, such as the IBM 360 machines which are no longer being supported by the manufacturer, or the degree to which the existing or planned hardware configuration could be upgraded to accommodate AREIS and to provide for possible expansion, (e.g., the implementation of other Education Center functions such as the evaluation of ACES programs mentioned earlier in this report). These questions should be answered by Project VIABLE, a research effort sponsored by the U.S. Army Computer Systems Command, which has been tasked to investigate existing BASEOPS computer facilities and to recommend how, and with what kinds of computer hardware, the Army should run its data management system in the future. This recommendation will be structured by the following parameters: 1) BASEOPS computers will be capable of handling interactive functions; 2) they will accommodate database management systems; 3) they will accommodate expansion of applications; and, 4) they will use data communication links such as AUTODIN II, a lease network similar to AUTOVON which transmits data rather than voice-grade communications. Project VIABLE is scheduled for completion early in 1982. The computers recommended by the Project VIABLE staff should, if all goes according to schedule, be installed during the period between late 1982 and 1984.

In order to make predictions about the possibility of implementing AREIS on Army posts worldwide by utilizing their present computer facilities, then, the following facts, some "knowable" and some "unknowable," would have to be obtained and evaluated:

1. the brands and models of machines on each post
2. the host operating systems
3. the types of language processors and methods of accessing files
4. the amount of core and disk storage, if any, which could be devoted to AREIS
5. the priority which Education Centers would get on post computers
6. the availability of computer staff to support this additional application.

If all the characteristics of the computer hardware could be known and if AREIS could be integrated into the ongoing operation of the post Computer Center, requirements for such integration would be as follows:

1. Commitment of sufficient core memory, telecommunications, and disk storage to support AREIS.
2. Commitment that the Education Center activity (i.e., AREIS) will have sufficient priority on the machine during the time of prime soldier use (on most posts this seems to be 8:00 a.m. to 4:30 p.m. daily).

3. Commitment of a sufficient amount of work time of one technically competent person in the Computer Center who will have responsibility for supervising the technical aspects of operation of AREIS, such as installing database updates and trouble shooting any problems reported by the Education Center staff.
4. Capability to provide response time of five seconds or less for soldier interaction with AREIS.

Should these requirements be already available and if the AREIS program were completed in a language compatible with the computer, the costs of implementation of AREIS on a given post using existing computer equipment, would include:

1. Installation of AREIS and related software into the computer.
2. Terminals and printers as desired, plus a monthly maintenance charge.
3. Phone equipment as needed. This may entail the installation of cables, if the Education Center is within 2000 feet of the Computer Center, and/or the addition of voice-grade or dedicated lines between 1) the Computer Center and the Education Center on an individual post and 2) among Computer Centers of all posts. Cost for these telecommunication links is determined by distance between the computer and between the computers and terminals. Acoustical couplers would also be leased or purchased.

The adoption of this alternative could be the most cost-feasible at this time because it assumes the use of existing hardware. It is not considered to be feasible, however, because of the following reasons:

1. There is little core or disk space available for AREIS or for future applications on existing machines without hardware upgrade.
2. There is no existing communication link among posts or between computer and Education Center facilities on individual posts.
3. The real-time processing necessary to provide a five-second response time is not available.
4. Project VIABLE recommendations must be considered when planning for the implementation of this alternative.

This information is summarized on page 18. This alternative is not included in Table 3 because it is considered not to be feasible at this time.

Three additional computerized means of providing AREIS to posts throughout the world are presented in the remainder of this section. In the discussion of these methods and their associated costs, the assumption is made that new equipment would be acquired for this application. For each of the proposed methods, the concept is described, and advantages and disadvantages of each are enumerated. The summary chart which follows the presentation provides an opportunity for easy comparison of these methods.

Alternative 2: The Maxi-Computer Concept

With this mode of delivery for AREIS, one large mainframe (MF), or central processing unit, would be placed in a desirable location (perhaps at the headquarters of the Department of Army in Washington, D.C.), and terminals (T) would be linked to it by means of data communication links (i.e., telephone lines or cables). Figures 2 and 3 illustrate this concept.

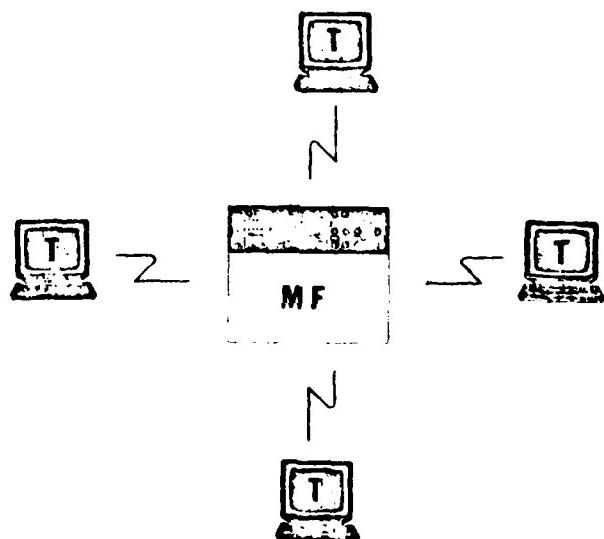


Figure 2

The Maxi-Computer Concept

Terminals (T) are connected to mainframe (MF) by telephone lines.

In this type of configuration, the number of terminals placed on a given post would depend upon the number of soldiers resident there. Small posts like Fort Ritchie (population 1550) would have one terminal, while large posts like Fort Bragg (population 48,000) might have in excess of twenty terminals. With a soldier population of approximately 400,000 in CONUS, if the Army were to accept the recommended ratio of one terminal per two thousand soldiers, there would be approximately 200 terminals attached to the central processing unit.



Figure 3
Illustration of the Maxicomputer Concept

Terminals on each Army post are connected to the maxicomputer by means of telephone lines.

The mainframe would be dedicated to the operation of ARFIS and would require a Computer Center staff of several people to maintain its operation.

The advantages of such a highly centralized operation would be as follows:

1. All operations could be centralized in one place with one staff responsible for computer maintenance, software maintenance and updating, and input of data from the central site.
2. Some of the important criteria for the system can be met. (See Summary Chart on page 18).

The disadvantages of this type of delivery are substantial. They include:

1. The very high cost of data communications. Because of the prohibitive cost of commercial telephone lines, it is unlikely that the Army would use this method of data communication. Since rates vary from state to state and are different for interstate and intrastate communication, precise figures have not been calculated. An example, however, will provide some insight into this issue. An interstate line from Washington, D.C., to California would cost \$9.00 per mile per month. At this rate, a telephone connection between the Pentagon and the Oakland Army Terminal would cost approximately \$27,000.00 per month.

The AUTOVON system, a telecommunication link leased by the Army is another alternative. It is less expensive than the regular commercial lines. It is still inadequate, however, because the quality of transmission does not permit adequate communication of data. Also, the present system allows for unannounced interruptions in service, a factor which makes it totally unsatisfactory for data transmission.

Instead, the Army would probably use dedicated lines, that is, telephone lines hard-wired directly from the mainframe to the terminals. Although use of dedicated lines also involves a high dollar outlay, these lines are less costly than their commercial counterpart, with a cost of approximately \$.75 per mile per month. For example, the cost for a dedicated line between Fort Sill, OK, and the Edgewood Arsenal, MD, is approximately \$1000.00 per month.

2. The memory disk file requirements would be very great. Each terminal requires between 4K (four thousand) and 8K (eight thousand) bytes of memory; therefore, placing an average of two terminals on each post in the continental United States would require 500K to one million (one megabyte) bytes just for commercial between the mainframe and the terminals. Additional core would be needed for the operating software, (e.g., for PLANT, if used; and for the AREIS courseware). Further, approximately 16K bytes of memory would be required for the storage of each DA Form 669. These massive requirements and the present hardware limitations (the largest mainframes are capable of 8 to 16 megabytes of memory and one billion bytes of accessible disk storage) would result in some combination of these two conditions:
 - a) the limitation of the number of terminals on posts; and/or
 - b) unacceptable (more than five seconds) response time for soldiers interacting with AREIS.

3. This method of delivery would be feasible for CONUS, but would not serve well outside the United States due to large distances between posts, the need to communicate over bodies of water, and the fact that there is a lack of uniformity of specifications among the variety of phone companies that would be involved.
4. This method of delivery would be the most expensive of the options. (See Table 3, Page 19).

Two different kinds of technical modifications can be made to this model to reduce the cost of communication. The first, illustrated in Figure 4, shows the addition of concentrators (C) to the model. These are devices which accept information from many terminals over slow-speed lines and transmit the data to the mainframe over a high-speed line. In other words, the terminals communicate with the concentrator, and the mainframe communicates with the concentrator. This "black box" allows the terminals to make a local call instead of a long distance call. Concentrators could be placed in the Education Division of each MACOM Headquarters, in locations which are central to large concentrations of Army personnel, and even on individual posts with large populations such as Fort Bragg or Fort Hood. If money could be spent to lease or purchase concentrators, therefore, relatively less money could be allocated for data communications costs.

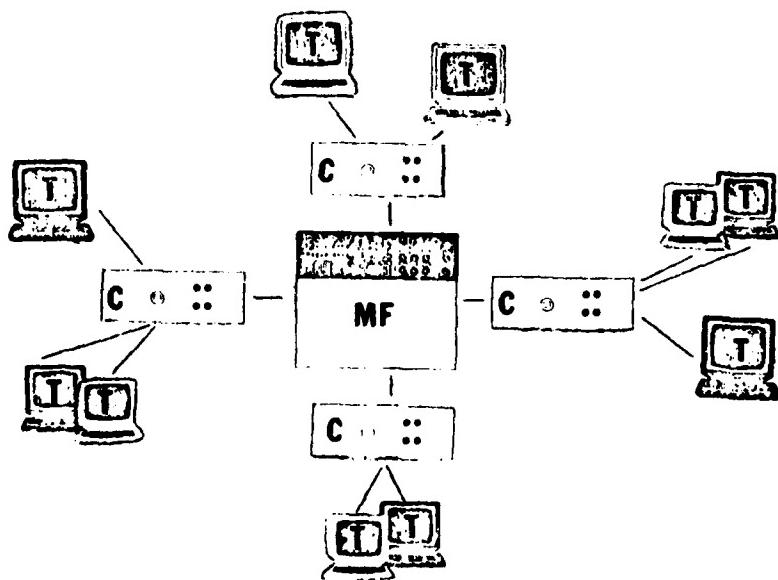


Figure 4

The Maxi-Computer Concept

Modified by the addition of concentrators (C) as interface between mainframe (MF) and terminals (T).

A second method of reducing phone line costs would be to contract with a common carrier for a network of lines dedicated to the transmission of computer data. AUTODIN II, which is similar to the presently used AUTOVON voice-grade communication system, is being considered for this purpose by Project VIABLE.

Alternative 3: The Distributed Network

A distributed network can be defined as a group of computers which share a work load in a real-time environment. This network can be made up of some optimal combination of maxi-computers (mainframes), mini-computers, micro-computers, and terminals. Figure 5 illustrates a distributed network in which mini-computers (MC) connected to a large central mainframe communicate with terminals. In this type of configuration, there is still two-way communication between the central mainframe and the remote sites. In addition, data storage and access can be decentralized by shifting all or parts of the database to the mini-computers, thus reducing memory stress on the mainframe, reducing data communications costs, and enhancing the response time. This mode of delivery provides for shared control, local and central, over the databases.

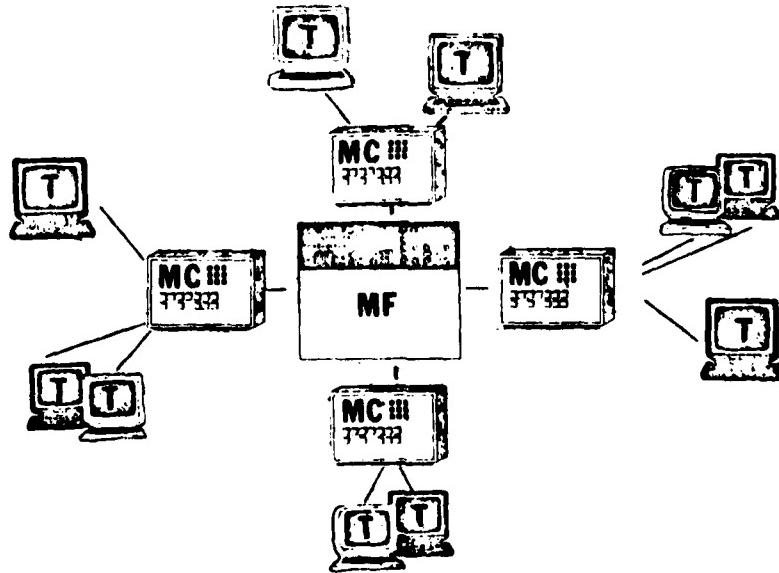


Figure 5

The Distributed Network Concept

Minicomputers (MC) are connected to mainframe and to terminals on Army posts.

A further refinement of this model is illustrated in Figure 6. This configuration, called a webbed network design, replaces the mainframe with a mini-computer, which costs less per unit of memory than the large machine. This network does not exclude the use of mainframes, however, if they prove cost-effective within the network. Existing mainframes could be linked into the design.

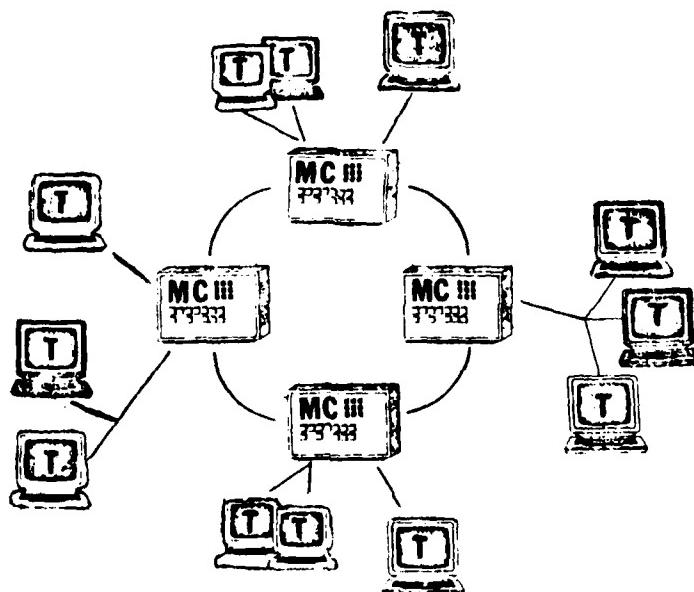


Figure 6

The Webbed Network Concept

Minicomputers (MC) are connected to each other and to terminals (T) on Army posts.

In the webbed network design, the central site becomes another "local" installation with the capability to transmit to and obtain inquiries and reports from all of the other installations. Almost all of the data processing operations are localized through the mini-computers. The ability to dial up, on an as-needed basis, any one installation from any other preserves the inter-post communication link at a much more cost-efficient level than in the maxi-computer model. Data updates can be made directly and on-line at one installation without affecting the operation of other installations.

In order to make this design operational, a mini-computer could be placed in the Education Division of each of the MACOM's. Each MACOM mini-computer would be linked to terminals on posts within that command and to the mini-computers in every other command. Because of the disparity in the size of military populations and number of posts within the various MACOM's and because the posts in each MACOM are spread over a wide geographical area (resulting in overlap of data communication links), this method of defining the distribution may pose some problems.

Another method would divide the United States into twelve regions, each of which contains a military population ranging from 20,000 to 70,000 soldiers. Each region, with a mini-computer in the center, would be linked to all terminals within the region and to the mini-computers in every other region. Such a network is presented graphically in Figure 7 and defined in Table 1.

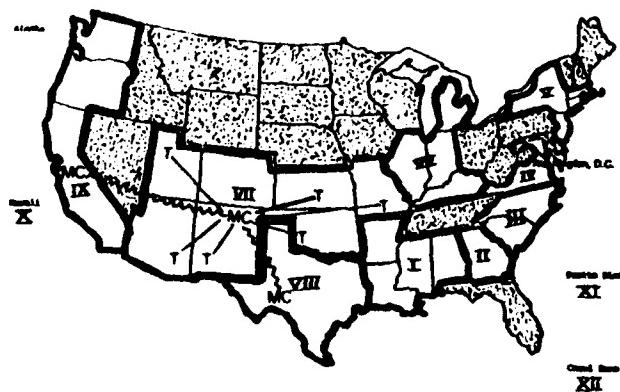


Figure 7

Illustration of the Webbed Network Concept

For this illustration, CONUS is divided into zones containing populations of approximately equal sizes. Minicomputers (MC) are placed within these zones and are connected to terminals (T) on posts within the zone and to other minicomputers in other zones. (See example in Zone VII).

TABLE I
NETWORK STRUCTURE

<u>REGION</u>	<u>STATES</u>	<u>POST</u>	<u>VI</u>	<u>Illinois</u> <u>Indiana</u> <u>Kentucky</u>	<u>Fort Sheridan</u> <u>Fort Benjamin Harrison</u> <u>Fort Campbell</u> <u>Fort Knox</u> <u>Selfridge AMG Base</u>
I	Alabama Arkansas Louisiana	Fort McClellan Fort Rucker Redstone Arsenal Fort Richardson Fort Polk		Michigan	
II	Georgia	Fort Benning Fort Gordon Fort McPherson Fort McPherson II Fort Stewart	VII	Arizona Colorado Kansas	Fort Huachuca Yuma Proving Grd. Fitzsimmons Army Medical Center Fort Leavenworth Disciplinary Barracks Fort Leavenworth Arms Center Fort Riley Fort Leonard Wood St. Louis Support Center White Sands Missile Range Fort Sill Dugway Proving Grd.
III	North Carolina South Carolina	Fort Bragg Fort Jackson		Missouri	
IV	Maryland Virginia	Aberdeen Proving Grd. Fort Detrick Fort Meade Fort Ritchie Arlington Hall Fort Belvoir Fort Eustis Fort Lee Fort McNair Fort Meyer Fort Monroe Hoffman Bldg. Vint Hill Farms		New Mexico Oklahoma Utah Texas	
	Washington D.C.	Pentagon Walter Reed Army Medical Center	IX	California	Fort Bliss Fort Hood Fort Sam Houston Fort Sam Houston Army Medical Center
V	Connecticut Massachusetts New Jersey New York	Fort Carson Fort Devens Fort Dix Fort Monmouth Fort Hamilton Seneca Army Depot West Point	X	Washington Hawaii	Fort Ord Oakland Army Base The Presidio Sierra Army Depot Port Lewis Port Shafter Puerto Rico
			XI	Puerto Rico	Port Buchanan Port Clayton
			XII	Canal Zone	

Because of the ability of each mini-computer to communicate with all the other mini-computers, the Education Division of MACOM's could continue to act as the intermediate link in the chain of communication from the Education Center to the Education Directorate, Headquarters, Department of Army.

The advantages of the distributed network design are as follows:

1. The data communications costs are greatly reduced from those of the centralized model.
2. The operation of the computer at a given site is not dependent upon the operation of the computer at one central site.
3. All of the criteria detailed on page 18 are met.

The disadvantages of the distributed network are:

1. More people are required because of the need for some technical support personnel at each of the distributed computer installations.
2. There must be compatibility across machines in terms of hardware, software, and database construction.
3. This delivery model would not function as efficiently for posts outside the continental United States because of the incompatibility of data communications services (as discussed earlier in the report).

Alternative 4: The Stand-Alone Micro-Computer Model

In this model, each post would have a stand-alone micro-computer in the Education Center. The computers within the micro-computer-based system may vary in size, cost, and capability from small machines to large. Each post would have a micro-computer and associated mass storage devices specifically assembled to handle the file storage requirements on that post. For example, a post of 1500 soldiers would have a relatively small micro-computer and floppy diskettes as file storage devices. A post of 48,000 soldiers would have a very large micro-computer (close to the size of a mini-computer), much more sophisticated communications with terminals, and larger file storage devices such as rigid disks. These variations are necessary due to the differing number of Forms 669 to be stored on each post and the number of users who might access the system at the same time.

The micro-computer proposed for each Education Center would be totally dedicated to the Education Center and initially would support the AREIS system. Later, other Education Center applications, such as those discussed earlier in this report, might be installed in the micro-computer.

This type of delivery model would be the easiest for the Education Center personnel to operate. AREIS would be started by turning on the micro-computer; it would be shut down by turning off the micro-computer. The operation would be virtually fail-proof. This level of operation can be achieved because the system is not operating other programs simultaneously and because there is no remote telecommunication requirement.

The micro-computer system could be engineered to operate one to eight terminals, depending upon the needs of each post. It is important to note that a well designed micro-computer system implementation can be expanded up to mini- or maxi-computers if the situation warrants such an expansion. Because such an expansion is possible, the micro-computer could be able to handle other data processing functions which are now handled in a "paper-pencil" mode.

Since this model assumes that there will be no real-time (computer-to-computer) data communications between and among the various links in the communications chain (Education Directorate, Headquarters DA; Education Divisions in the MACOM's; Education Centers on all posts), the model must accommodate another means of transmitting data, such as in the transfer of Form 669. It is proposed in this model that this communication of data be accomplished by means of a specially formatted floppy diskette sent through the mail. For example, when it is known that a given soldier will be transferred from one post to another, his/her Form 669 would be transferred (often with others) to a floppy diskette which is then mailed to the next post and there installed into the file. Similarly, the Education Directorate might communicate new regulations to the Education Divisions of MACOM's and to Education Centers on posts by sending out as often as needed a floppy diskette which could be used to update all or part of AREIS. Floppy diskettes are inexpensive at approximately \$4.00 each (commercial price for one diskette; large quantity purchases would lower cost significantly) and can be reused many times; typically 10,000 - 20,000 transfers per diskette.

At some point in the future it is expected that posts will want to have real-time communications; a simple change in device drivers will allow the entire system to function over a data communications channel. (In fact, this concept would allow the Army to mix real- and non-real-time record transmission). In the event of an error in data transmission, a hard copy or new floppy diskette would be transmitted to the new post. To prevent loss of data, the procedure would require a positive response from the receiving post before a transmitting post would be able to purge a soldier record. A purge would be a normal archive to magnetic media to be held for a specific period (typically two to three years).

The advantages of the micro-computer model are:

1. Remote data communication costs are eliminated.
2. The Education Center is directly involved with the operation and maintenance of the system.
3. The system can be maintained with a minimum of technical and clerical support.
4. Overall system operation will be easy for non-technical people and reliable.
5. This model would fit all posts, including remote overseas installation.
6. Most of the criteria detailed on page 18 are met.
7. The cost for such a system will be less than that for the maxi-computer or distributed network modes of delivery.
(See page 19).

The disadvantages of this model are:

1. Real-time communications "horizontally" among posts or "vertically" along the chain of command, that is, among Department of Army, MACOM Headquarters, and posts, would not be possible without modification to the hardware, which would increase the cost.
2. The system may not have the capability of incorporating new applications without hardware upgrade.

Other Related Costs

Each of three proposed modes of delivery of AREIS has its price tag. The cost of the technical delivery method is not the only aspect of the project to have an economic impact; costs for the development of the remainder of AREIS as conceptualized, costs for the installation and updating of the system, costs for AREIS-related personnel (other than technical staff), and costs for inservice training for the on-site administrative, guidance, technical, and clerical staff at the time of installation of AREIS must be considered.

Development costs: Several pieces of AREIS were written and programmed for the current project. They include all of Subsystem I, approximately one-third of Subsystem II, approximately one-twelfth of Subsystem III, and the basic layout of some suggested portions of Subsystem IV. The actual text writing and programming of this much of AREIS was a 9.4 person-month effort, costing approximately \$15,750.00. Future development would include some revision to the existing text (as a result of information gained during the field tryout activity), and the data collection, text development, and programming of the remainder of the conceptualized system. Because some of the ground work has already been laid for the future development, it is estimated that the balance of AREIS could be completed during a one-calendar-year period using a staff of four: two script developers, one programmer, and one clerical support person.

It is assumed that the programmer will have knowledge of the language used to implement the system. If the programmer requires training in the programming language, it is possible that the total-time estimate for the completion of AREIS may be altered somewhat. If PLANIT is used as the programming language, further development to include a database search capability should be completed. This task would be separate from the completion of AREIS and would not be undertaken by the staff mentioned above.

Installation/Update costs: Any computer-based information system has at its heart the capability to search and retrieve information from current and accurate databases. AREIS would be no exception. If the system as conceptualized is to be completed and utilized on Army posts, there will be databases, such as the occupational, military, and two- and four-year college databases, which will have to be installed and updated on a regularly scheduled basis. Some databases can be purchased from outside agencies. Some technical effort, depending upon the mode of delivery selected for AREIS, will be required by AREIS personnel to install and/or distribute the database updates. In addition, a number of frames in the AREIS text will need localization and updating. For example, in Subsystem III, To Complete a Next Step in Education, contains frames which list the master schedule of courses offered on or near post. This information must be input into the appropriate frames with each change in the education cycle.

Personnel costs: In each Education Center some staff member(s) will have to assume responsibility for AREIS. Tasks for successful operation will include developing procedures for data entry, updating and transmittal of DA Form 669; publicizing the system to all service members on post; developing procedures for scheduling soldier use; and becoming sufficiently familiar with the hardware and software to be able to report problems. In addition, clerical support will be necessary for the actual entry, update, and transmittal of the DA Form 669's and the scheduling of soldiers to use the AREIS terminal.

Inservice Training Costs: Experience with other computer-based information systems indicates that the orientation and inservice training about the theoretical base, the specific content, the components of the delivery system, and the integration of the program into the total guidance program must be considered as an integral factor in the successful operation of such a system. All on-site personnel who will have involvement with the computer-based system—administrators, counselors, technical personnel, and clerical support—should take part in the initial two-to-three-day inservice training. Therefore, inservice training cost must be considered as it applies to the time of these personnel away from their regular duties and to the time and expenses of the inservice trainers.

Table 2
Summary Chart
Mode of Delivery and Selection Criteria

Criteria to be met	Mode of Delivery	Existing Facilities						
		1	2	3	4	5	6	7
Total ARBTS Systems to include Form 669 storage or retrieval	No	No	No	No	Yes	Yes	Yes	Yes
Support of other computerized functions such as might be developed later	Yes	Very Doubtful	Yes	Doubtful	Yes	Yes	Yes	Yes
Communication Link among Army Posts, MRCOM's, and Department of Army	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Possible**
Response time of less than 5 seconds	Yes	Yes	Possible*	Yes	Yes	Yes	Yes	Possible**
Capable of handling terminals in a variety of configurations	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Minimun of on-site technical aid	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PLANT software used only after major modification	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

*by using floppy diskettes (telecommunication is a future option with a concomitant increase in cost).
**PLANT software is being developed for use on a CROMEXCO micro-computer under a separate ARU contract.

Table 3
Summary Chart
Comparison of Costs: Modes of Delivery¹

<u>Cost Category</u>	II <u>Maxi-Computer</u>		III <u>Distributed Network</u>		IV <u>Micro-Computer</u>	
	<u>Low</u>	<u>High</u>	<u>Low</u>	<u>High</u>	<u>Low</u>	<u>High</u>
Hardware Cost	\$5 million	\$6 million	\$2.5 million	\$3 million	\$1.1 million	\$1.2 million
	(One 8-megabyte mainframe with 100 terminal ports)	(12 mini-computers linked in a single network)	(62 single computer sites in the United States)			
Terminal Cost ²				<u>Mid-Range</u>		
			\$500,000			\$500,000
Communications Cost	<u>Low</u> \$200,000/yr	<u>High</u> \$300,000/yr	<u>Low</u> \$25,000/yr	<u>High</u> \$100,000/yr	<u>Low</u> \$1.00	<u>High</u> \$4.00
	(Using remote concentrators within the United States only. Worldwide communication cost prohibitive).	(No dedicated links. Over-night transmission on as-needed basis).	(Cost of one floppy diskette total annual cost not calculated).			
Data Processing Costs ³				<u>Mid-Range</u> \$310,000		
	(Based on 6 programmers and 9 computer operators)	(Based on 10 programmers and 15 computer operators)	N/A			

¹Alternative 1; Use of Existing Computers, is not included in this table because it is considered not feasible at this time.

²Ratio of 1 terminal: 2000 soldiers. \$2500.00 per terminal including printer. A 18 monthly maintenance fee must also be considered when calculating terminal cost.

³Programmer/Systems Analysts, GS11, Step 4: Base Salary plus 15% fringe benefits. Computer Operators, GS5, Step 4: Base Salary plus 15% fringe benefits.

BENEFITS OF USE OF AREIS

Benefits From Systems in Other Settings

The use of the computer to provide assistance with vocational and educational choices dates back to 1966. Since that year, at least 30 systems have existed, and the movement has experienced at least three generations. The first generation of systems (approximately 20 of these) was batch-processed; that is, a user completed a form on which desired characteristics of occupations or educational institutions were delineated. This form was sent to a central computer system and, along with many others, was processed against the computer's data files. This process produced a list of options (occupational or educational) which contained all of the desired characteristics although the inquirer was uninformed about the extent to which specific variables narrowed available choices. This generation of computer-based guidance, though cost-efficient, had little user appeal and failed financially.

The second generation of computer-based systems, developed simultaneously, used on-line technology. In other words, users communicated directly with the computer by means of cathode ray tube or typewriter terminals connected to the computer. This technology allowed the capability to develop interactive dialogue between the user and the computer and provided the great advantages of immediate feedback, user control, and constant knowledge of the limiting or broadening effects of decisions which were being tentatively made. These second generation systems [examples: Computerized Vocational Information System (CVIS), Guidance Information System (GIS), Career Information System (CIS), Computerized Heuristic Occupational Information and Career Exploration System (CHOICES)] make maximum use of two powerful computer capabilities: search strategies through large data files by the successive addition of selection criteria and the retrieval and display of comprehensive files of information about occupations and educational programs and institutions.

A third generation of computer-based guidance systems [examples: DISCOVER and System for Interactive Guidance Information (SIGI)] provide the capabilities of the second generation, but add still others. These include instruction about values, decision making, organization of the world of work and many other guidance topics, as well as the on-line administration of interest inventories and other assessment devices.

Systems of the second and third generation have been extensively evaluated over the past ten years. The most typical sites for the testing of these systems have been secondary schools, community colleges, and more recently, four-year institutions. Other sites of their installation have included state employment service agencies, CETA agencies, community career guidance centers, and prisons. Although these systems have not been utilized on Army posts, it is reasonable to

assume that they have been tested with many subjects who later enter military service and that the Army's enlisted personnel constitute a subset of the total population with which they have been tested. It is also reasonable to assume that the benefits which have been identified through twelve years of research on systems in other settings will also apply to systems designed for and used by Army enlisted personnel. From an extensive review of the literature from 1968-1980, the following nine benefits have been identified and documented in the research reports cited:

Benefit #1: Receiving information from computer terminals is viewed by users as an extremely interesting way to get information, and is preferred over the other traditional means.
(Impelleteri, 1968; Thompson et al., 1970; McKinlay & Adams, 1971; Harris, 1972; Harris-Bowlsbey, 1976).

In all of these studies more than 90% of users indicated a high level of interest and motivation in utilizing a computer terminal for career guidance and information. Further, users of all ages and levels of intelligence learn to use systems easily and do not feel dehumanized by them.

Benefit #2: Use of computer-based career guidance systems increases awareness of educational and vocational options and causes individuals to consider a larger number and a broader range of alternatives. (Impelleteri, 1968; McKinlay & Adams, 1971; Myers et al., 1971; Harris, 1972; Harris-Bowlsbey et al., 1976).

One of the intense problems in career choices, especially among minority and deprived groups, is the lack of knowledge about a sufficient number of alternatives. A positive effect, then, of computer-based systems is to counteract this tendency.

Benefit #3: Use of computer-based career guidance systems causes the user to move toward crystallization of vocational choice.
(Impelleteri, 1968; Thompson et al., 1970, McKinlay & Adams, 1971; Myers et al., 1971; Harris, 1972; Harris-Bowlsbey, 1976).

This benefit appears to be in contradiction to the previous one. In actuality, systems have both effects. For many, alternatives need to be expanded as an early part of the decision-making process. After more alternatives are considered, the information available in the systems then assists deciders to narrow options and make moves toward specificity of choice.

Benefit #4: Use of computer-based career guidance systems motivates exploratory behavior after leaving the terminal. (Impelleteri, 1968; Thompson et al., 1970; McKinlay & Adams, 1971; Harris-Bowlsbey et al., 1976).

Exploratory behaviors observed in these research reports include talking with counselors about career planning, talking with parents about career planning, reading appropriate resource materials, and writing to appropriate sources for further information. These are action steps which indicate an increase in vocational maturity and progress toward the specification of vocational and educational goals.

Benefit #5: Use of computer-based career guidance systems causes an increase in cognitive knowledge about occupations and/or educational programs researched by the user. (Impelleteri, 1968; Harris, 1972; Harris-Bowlsbey et al., 1976; Heller & Chitayat, 1976).

In other words, if users are asked about specific information on occupations of their selection both prior to and after use of a computer system, they will demonstrate a measurable increase of cognitive knowledge about those occupations after system use. This cognitive knowledge consists of factual information about work tasks, training, salary, benefits and limitations of the occupation, employment outlook, and sources of further information.

Benefit #6: Use of computer-based career guidance systems cause an increase in self-information and awareness and relationship to self-variables (i.e., interests, abilities/skills, values) to occupations. (Impelleteri, 1968; Thompson et al., 1970; Harris, 1972; Harris-Bowlsbey et al., 1976).

Career development theory indicates that the choice of an occupation should be the implementation of a self-concept (Super, 1953). This involves two steps: the formation of a clear and realistic self-picture and the translation of this into occupational choice. The available research indicates that this process is assisted by the use of computer-based systems which address interests, abilities, skills, and/or values.

Benefit #7: Use of computer-based career guidance systems cause a statistically significant increase in vocational maturity as defined and measured by Super and the Career Development Inventory. (Myers et al., 1971; Harris, 1972).

Myers et al., and Harris found an increase in two specific factors of vocational maturity: 1) awareness of need to plan ahead and 2) knowledge of informational resources. While Harris found this increase in white subjects across grade levels, Myers et al., found this increase with black urban samples.

Benefit #8: Use of computer-based career guidance systems may cause an increase in decision-making skills. (Impellitteri, 1968; Myers et al., 1971; Harris, 1972; Heller & Chitayat, 1976; Cochran, 1977).

In most of these reports this improvement was self-reported only and without operational definition.

Benefit #9: Use of computer-based systems maximizes the career guidance gains which can be effected by counselors. (Thompson et al., 1970; Melhaus, 1971; James & Smith, 1972; Pyle & Stripling, 1976; Sampson & Stripling, 1979).

Much of the research on computer-based guidance cited in Benefits 1-8, has studied the effects of the computer alone. The researchers listed here studied the effects of the use of computer alone versus the combination of counselor and computer intervention. From most studies, it appears that the greatest guidance gains can be made if clients receive integrated treatment from the computer and the counselor.

Benefits From the OCIPS Field Tryout

In 1976 the Army Research Institute field tested three modules of the Officer Career Information and Planning System (OCIPS) with 52 officers at Fort Benning, Georgia. Those three modules were: 1) FORESIGHT, which provided general information about career planning; 2) OVERVIEW, which provided general information about the Army officer career structure; and 3) ALTERNATE, which provided the characteristics of officers who received various alternate specialty designations. Each of the 52 officers spent approximately three hours at the computer terminal using these three modules and completing evaluation instruments. All users of the system took a pre-test and a post-test, and volunteers responded to interview questions in a debriefing session.

Based upon the findings of these instruments and interviews, the following benefits can be claimed for the OCIPS system:

1. The computer was viewed as a more effective mode for delivering information than traditional means already in use.
2. The content of the modules was perceived as interesting, understandable, and accurate.
3. Use of the system had the effect of decreasing officers' need for career information.
4. Use of the system had the effect of increasing scores on a career information test.
5. Use of the system had the effect of increasing certainty of and satisfaction with alternate specialty preference.

Benefits From the AREIS Field Tryout

During the month of April 1980, the DISCOVER Foundation conducted a field tryout of AREIS was conducted at Fort Sill, Oklahoma. The following portions of the total system were tested:

1. Subsystem I, Orientation: an overview of AREIS itself, of the services provided to soldiers by the Education Centers, and of the various programs offered by the Army Continuing Education System.
2. Subsystem II, Self-Information: the UNIAC Interest Inventory (© 1978, American College Testing Program)
3. Subsystem III, Goals and Planning: the goal entitled, "To Complete a Next Step in Education," designed to provide detailed information about the educational offerings on or near a specific Army post.

4. Subsystem IV, The Counselor-Administrator System: a demonstration package of various administrative functions which might be computerized for counselor use.

Subjects for the field tryout were volunteers from the many soldiers who came to the Education Center on their own and from the BSEP II program operating in a nearby building. No soldiers were taken from their military duty assignments to participate in the tryout. Counselors and other staff members were also invited to use AREIS and to interact with Subsystem IV. Once the subjects were introduced to AREIS and to the purpose of the field tryout, they were left alone to interact with the system in a manner determined by their time limits and by their interest in the information. No attempt was made to structure the AREIS experience.

Sixty-four soldiers and twelve counselors used AREIS. The soldiers each took an on-line, pre-use questionnaire and also responded to a survey after each subsystem. These surveys provided feedback about the usefulness, understandability, and interest level of that subsystem. The soldiers were also asked if they would recommend that portion of AREIS to a friend. Some soldiers also took an on-line, post-use questionnaire. Several items on the pre-use and post-use questionnaires were identical; in this way the effect of system use on the attitude of subjects was analyzed.

Based on the information provided by these on-line evaluation instruments, the following conclusions can be drawn about the benefits derived from AREIS use:

1. The computer was perceived to be useful for help with vocational planning. Before using AREIS, 82% of the soldiers believed that AREIS would help with job planning; after AREIS, that percentage rose to 94%.
2. The computer was perceived to be useful for help with educational planning. Prior to system use, 84% believed AREIS would be helpful; that figure rose to 94% after system use.
3. The content of the soldier subsystems developed for the field tryout was perceived as useful. Subsystem II, Self-Information, was viewed as the most useful, with 95% of the users reacting positively to the content.
4. The content of the soldier subsystems was perceived as interesting. Subsystem II was the most interesting portion of AREIS, with 95% reacting favorably to the subsystem.
5. AREIS users, soldiers coming from a broad spectrum of educational experience, found the language used in AREIS to be understandable. 85%-91% of the users reported that they had no difficulty understanding the content of the three subsystems.
6. The AREIS experience was perceived very favorably by the users. 95%-98% of the subjects indicated that they would recommend AREIS to a friend. Four users did, in fact, bring a total of ten others to the terminal.

7. Counselors also reacted favorably to AREIS. They felt that the information presented in the soldier subsystems was accurate and appropriate. They also felt that the style of presentation was appropriate. Their reaction to the use of a computer to deliver educational information to soldiers was very positive.
8. Counselors also responded favorably to the information presented in the demonstration package in Subsystem IV. They felt that the information was accurate and that it was displayed in an appropriate format.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The purpose of this document is to project both the benefit and the cost of the implementation of AREIS on Army posts worldwide. Based on the findings from evaluations and field tryouts of similar systems in the civilian sector and on the field tryouts of the Officer Career Information and Planning Systems (OCIPS) and AREIS, the following benefits are projected:

1. Soldiers will be highly motivated to use AREIS, and, as a result, they will learn more about the ACES programs and take better advantage of them.
2. Soldiers will have greater access to a systematic program of counseling and information services which will offer self-assessment (interests, skills, values) and assistance with specific goal setting while in the military.
3. The questions which soldiers ask of Education Center counselors will be more detailed in nature. The demand for counselor assistance will not be reduced; instead, the work done by counselors will be at a higher professional level.
4. Soldiers will be counseled on the basis of improved information. DA Forms 669 should be more accurate, regulations should arrive from the Education Directorate, Headquarters, Department of Army, more quickly, and the quality of all information available to service members should be more consistent and objective.
5. There should be a measurable improvement in knowledge about ACES programs, self-knowledge, career planning and decision-making skills.
6. Counselors will be able to reach a larger percentage (an increase over the present 64%) of their clients with educational information because they will have computer terminals as additional purveyors of information.
7. This increased assistance to a larger percentage of the soldier population should result in an increase of planful goal setting which would result in:
 - a. more soldiers taking advantage of ACES programs, which in turn will help them toward better performance and promotion
 - b. more soldiers doing better promotion planning resulting in a higher retention rate
 - c. greater satisfaction with the Army because of the ability to relate its educational and vocational opportunities to civilian life
 - d. improved transition from military life to civilian life.

8. Counselor and FSO clerical load should be redefined because of the computerization of Form 669 and other functions proposed in Subsystem IV. Counselors would have more time for one-to-one counseling and consultation activities.
9. Communication among posts, Education Division of the MACOM's, and Education Directorate, Headquarters, Department of Army, should be improved.

All benefits have concomitant costs, and AREIS is no exception. Part II of this report described three different modes of delivery of AREIS. The first mode, the maxi-computer carries a very high price tag. Models two and three, the distributed network model and the micro-computer model, are both more cost feasible, with the micro-computer being the most cost effective of all the models. It is possible that the ideal method of delivery would put models two and three in combination. The distributed network would be very cost feasible for some posts which already have some computer capability and which are in reasonable geographic proximity to other posts. The micro-computer model would be more feasible for small posts which currently have no computer capability and which are separated by long geographic distances. Such a combination delivery system could solve the problem of delivering AREIS worldwide. Posts within CONUS could use either the distributed network approach or the micro-computer method, and posts outside CONUS would use the micro-computer method, thus eliminating the data communications problems.

This method of delivery also offers the advantage of flexibility. As requirements on posts change, the type of delivery system might change. For example, a post which has an increase in soldier population might upgrade its facilities to include a mini-computer while another post which has experienced a reduction in military personnel might change to a micro-computer.

Recommendations

All of the information generated during this contract indicates that a computer-based education information system such as AREIS is both needed and beneficial for military personnel. It would also be important to the efficient operation of the Army Education Centers and their personnel as they attempt to provide current and accurate information to their clients.

Because the brief field tryout of April 1980 was formative in nature and thus presented only a portion of AREIS to a limited number of subjects, it is recommended that AREIS be completed as conceptualized, installed on a micro-computer, and subjected to a rigorous evaluation over a protracted period of time. Specifically, the process would be as follows:

1. Write and program the complete AREIS.
2. Install the system in a low-cost micro-computer selected by Army personnel.
3. Install all equipment in the Education Center of a large Army post.
4. Train all personnel involved with the subsequent operation of AREIS in the conceptual base and use of AREIS.
5. Operate the system under actual conditions for one year.
6. Monitor the use of the system by making, during this period, brief on-site visits to evaluate AREIS operation and to make suggestions about the ongoing operation of the program.
7. Conduct a final evaluation on all aspects of the AREIS program and its effect on the overall operation of the Education Center.
8. Write comprehensive report on the project including recommendations for further implementation of the AREIS system in the Education Centers.

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